IDAHO DEPARTMENT OF FISH AND GAME

FINAL REPORT

McCALL SUMMER CHINOOK NUTRITION EVALUATION STUDY

BY

BILL HUTCHINSON

September 1, 1983 - September 30, 1985

Prepared for

Lower Snake River Compensation Plan
U.S. Fish and Wildlife Service
Contract No. 14-16-0001-83267

July 1986

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

An unknown disease has afflicted summer chinook salmon fry at the McCall Hatchery since operation began in 1980. Known as Spring Thing (ST), it has been responsible for mortality rates as high as 27% (Thorpe and Hutchinson 1983). Early investigations supported the theory of a nutritional problem caused in part by dietary deficiency.

Comparisons between mortalities of summer chinook with ST and "downriver" spring chinook with Dropout Disease, as described by Wood (1979), has consistently been made with no documented differences between the two. Although similar in etiology, actual progression of the diseases were markedly different. Various federal and state hatcheries where these diseases occur have intensely evaluated these syndromes in hopes of defining the extent and nature of ST and dropout.

In 1984, the McCall Hatchery began an intensive two-year investigation evaluating various diets on the occurrence of ST. Results indicated this syndrome to be diet related caused in part by a vitamin deficiency of pantothenic acid (B vitamin) and the rearing of chinook fry for extended periods in water temperatures of 36-39 F (Hutchinson and Chacko 1985). This report is the conclusion of that two-year evaluation.

OBJECTIVES

1. To see if ST mortalities can be prevented by supplementing a commercially prepared Oregon Moist Pellet (OP-4) diet with pantothenic acid or by feeding Biodiet.

2. To systematically characterize the onset and progression of ST and dropout mortalities by measuring clinical and histological changes in various tissues and organs.

3. To compare and contrast ST and dropout mortalities and determine if a common cause exists.

METHODS

Summer chinook fry from the 1984 South Fork Salmon River brood year were used in the 139-day diet study. Approximately 87,000 swim-up fry from a common egg take were randomly assigned to one of four tanks and reared under standard production conditions. Rearing volumes were equal, and flows for all tanks were increased as necessary but kept within 5% of each other throughout the study. All tanks were fed, cleaned, sampled and treated similarly.

Four diets were tested: OP-4, OP-4 plus multiple supplements (vitamins A, B2, C, pantothenic acid and salt), OP-4 plus 10 times the normal amount of pantothenic acid and Biodiet. The OP-4 diets were open formula feeds manufactured by Moore Clark Company, LaConner, Washington. Biodiet is a closed formula feed manufactured by Bioproducts, Inc., Warrenton, Oregon. Test diets were fed at equal levels corrected for amounts of dry matter using identical methods and frequencies.

Representative samples of fish collected from the head, middle and lower ends of each tank were weighed, measured and counted on the 1st and 15th of each month. Daily feed requirements were calculated on a percent-body-weight basis, and fish were fed by hand 10 times per day. A special random sampling procedure, as outlined by George Ketola (1985), was used to ensure representative data on fish from large populations without using large numbers of samples. Sampled fish were preserved in Bouin's solution and sent to Charlie Smith, Fish Cultural Development Center, Bozeman, Montana for histological examination.

Data for mortality, growth and feed conversion were analyzed with the aid of a micro-computer compiled and reported by George Ketola.

RESULTS

Fish in all test groups suffered mortalities from ST. Mortalities began at about 260 temperature units (TU) and subsided as fish accumulated 600 TU (Fig. 1). ST mortalities in fish fed OP-4, OP-4 + supplements, OP-4 + pantothenic acid and Biodiet were 18.4, 5.2, 3.8 and 2.4%, respectively (Table 1). Mortality in all test groups prior to and after the outbreak of ST was comparable (Table 1).

Condition factors (K-factors) of normal, moribund fish with ST and "pinheads" were taken to document actual differences between these fish. Normal fish had K-factors in the 80's, ST fish were in the 60's, and "pinheads" had K-factors in the 50's (Table 2).

Moribund and clinically healthy fish were examined histologically by Charlie Smith. Results were essentially the same as those reported last year by Hutchinson and Chacko (1985).

Carcasses of normal and moribund fish were analyzed for pantothenic acid levels in body tissues. Results showed apparently deficient levels in both normal and moribund fish fed OP-4 (3.8 ppm and 4.6 ppm) while fish fed Biodiet showed pantothenic acid levels of 11.0 ppm.

The test group on Biodiet achieved the best feed conversion (1.2) and weight gain (2.66 grams/fish) while fish fed OP-4 had the poorest conversion and weight gain (Table 1). Groups on OP-4 + supplements and OP-4 + pantothenic acid were almost identical in conversion (1.5 and 1.4, respectively) and weight gain (2.26 and 2.23 grams/fish) (Table 1).

Table 1. Nutrition study data comparing four diets for 139 days.

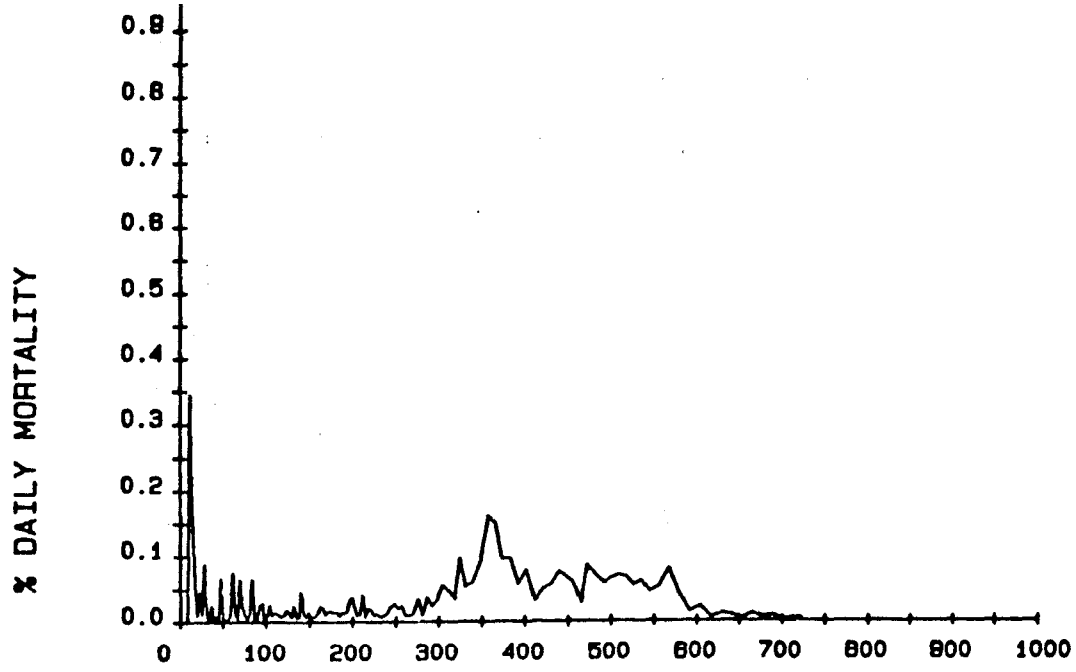
	OP-4	OP-4 + SUPP	OP-4 + PA[1]	Biodiet
TU=0				
Body wt (g/fish)	0.38	0.38	0.38	0.38
TU-109				
Gain (g/fish)	0.08	0.08	0.11	0.05
Mortality %[2]	1.0	1.1	1.2	1.2
Conversion	6.6	6.7	4.7	9.9
TU=197				
Gain	0.20	0.24	0.22	0.22
Mortality	1.4	1.6	1.6	1.7
Conversion	5.3	4.4	4.7	4.4
TU=260				
Gain	0.32	0.38	0.38	0.38
Mortality	1.6	1.8	1.8	1.9
Conversion	4.2	3.6	3.4	3.3
TU=314				
Gain	0.41	0.56	0.56	0.62
Mortality	4.4	2.7	2.2	2.4
Conversion	4.2	3.0	2.8	2.4
TU=461				
Gain	1.04	1.07	1.11	1.24
Mortality	15.8	5.7	4.3	3.6
Conversion	2.3	2.0	1.8	1.5
TU-707 (end)				
Gain	1.90	2.26	2.23	2.66
Mortality	20.0	7.3	5.6	4.4
Conversion	2.1	1.5	1.4	1.2
Mortality %				
TU=50-200	0.7	0.8	0.7	0.8
TU=260-600 (Spring Thing)	18.4	5.2	3.8	2.4
TU=600-707	0.9	1.3	1.1	1.2
Total	20.0	7.3	5.6	4.4

[1]Pantothenic Acid
[2]Mortality is cumulative

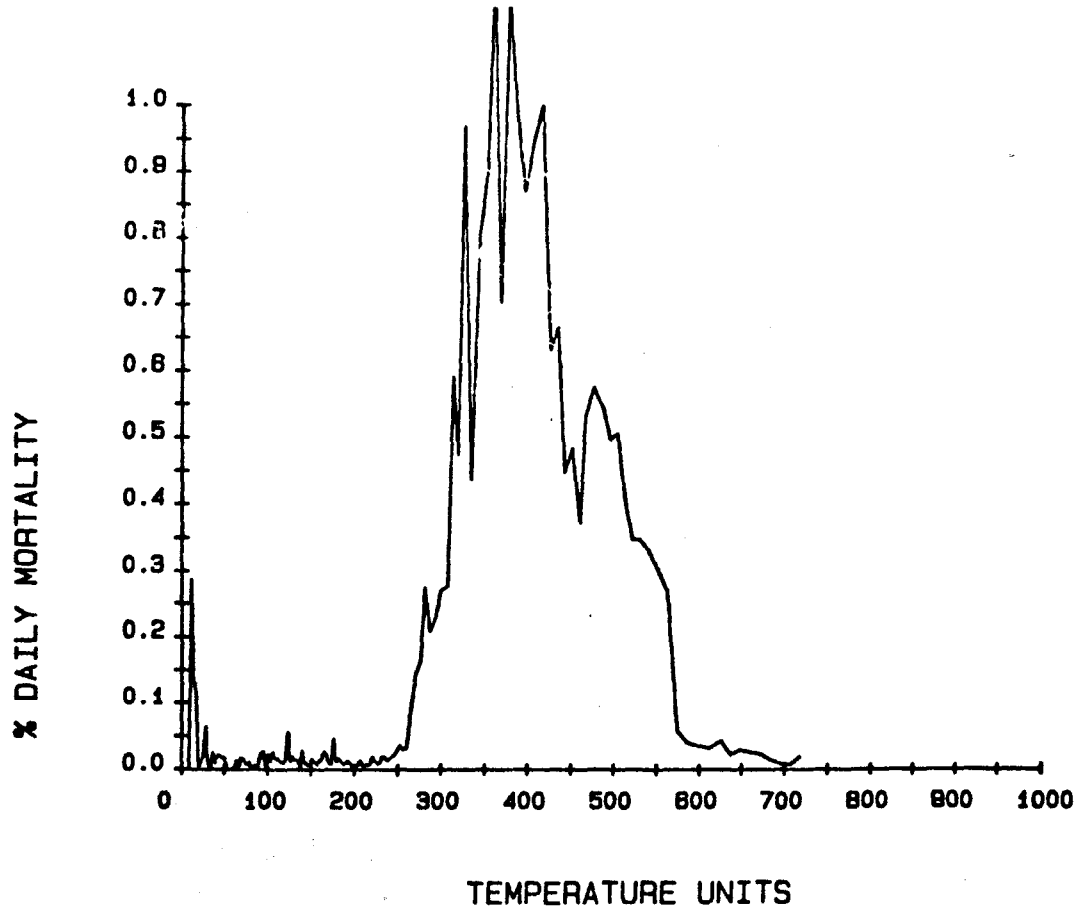
Table 1. Condition factors[1] of normal and moribund fish.

TU	Health of fish OP-4	OP-4	OP-4 SUPP	OP-4 PA	Biodiet
0	Normal (N)	78	78	78	78
100	N	82	80	79	77
197	N	72	77	77	79
320	Moribund (M)	66	71	--	
400	N	73	89	90	83
400	M	65	86	58	59
461	N	83	86	88	89
488	M "pinheads"	48	53	50	57

[1]Weight of fish in grams/length in mm^3 x 10^{-7}

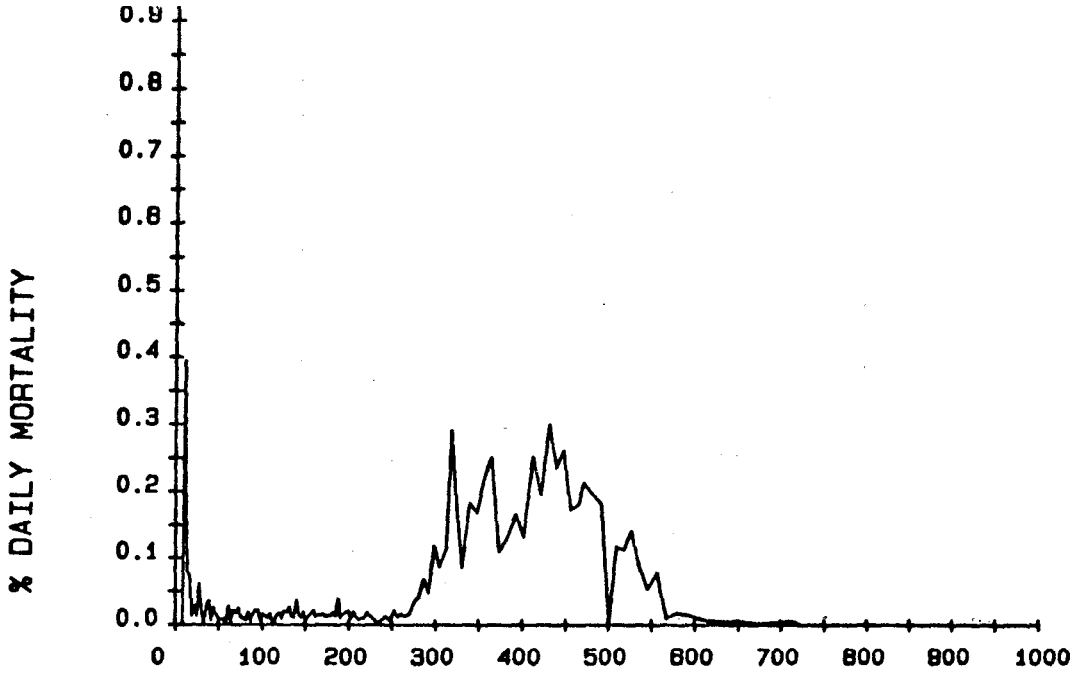


BIODIET
TANK 7
McCALL

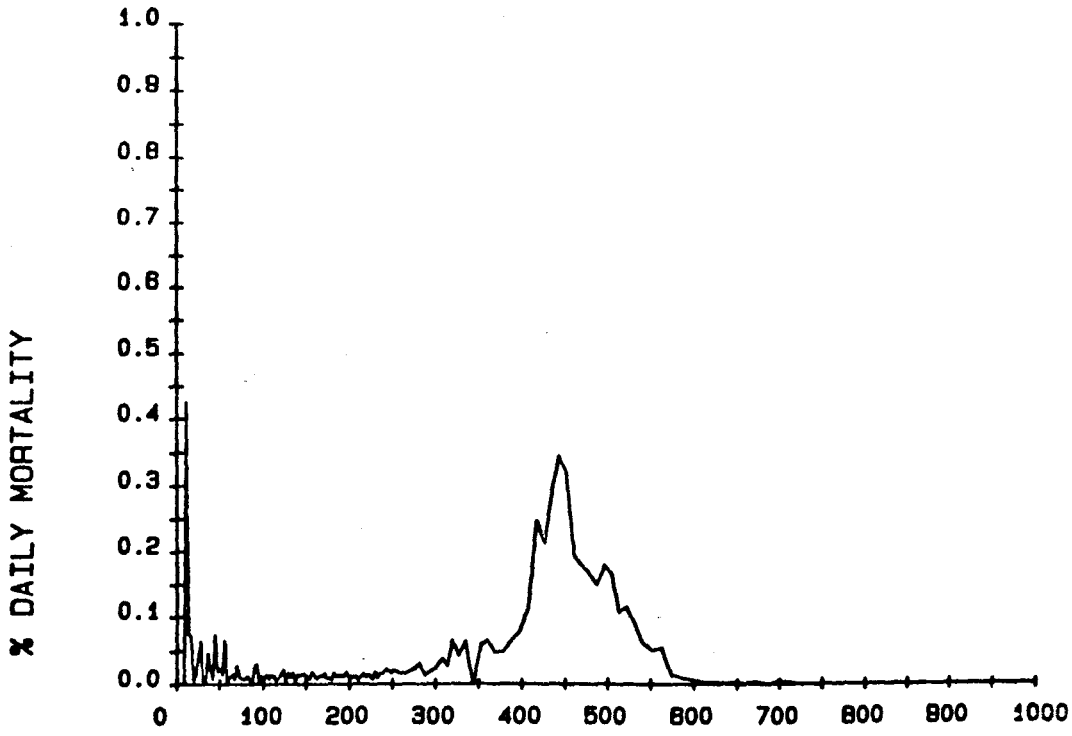


OMP
TANK 9
MCCALL

Figure 1. Comparison of mortality with age in test groups.



OMP + SUPPLEMENTS
TANK 8
MCCALL



OMP + PANTOTHEMIC ACID
TANK 10
MCCALL

Figure 1. Continued.

DISCUSSION

Diet studies at McCall during the past five years have resulted in substantial progress into the identification, cause and reduction of fish mortalities resulting from ST. Results indicate the syndrome to be a nutritional problem caused in part by a dietary deficiency of pantothenic acid and the rearing of chinook fry for extended periods in water temperatures of 36-39 F.

All test diets contained nutrient levels in excess of the National Research Council's recommended dietary levels for salmonid fishes (National Research Council 1981). Analyses conducted by George Ketola for pantothenic acid levels in carcasses of moribund and normal fish suggest that ST is related to inadequate levels of this vitamin in body tissues (Ketola 1985). Supplementation of the commercial OP-4 diet with pantothenic acid has shown to be effective in reducing mortalities associated with ST at the McCall Hatchery.

Analysis of data from hatcheries involved in investigating ST and dropout disease have shown marked differences between these syndromes. Whereas ST mortalities usually begin at about 260 TU and end near 600 TU, dropout mortality was shown to start at 500 TU and subside at 800 TU (Ketola 1985). Fish identified with ST usually died within a few days and had relatively good body condition while dropout fish survived considerably longer and had poorer K-factors. K-factors of normal fish ranged from 77-90 while moribund ST fish showed K-factors between 66 and 86 and dropout fish 50-66 (Ketola 1985).

It is felt that although these syndromes are similar in etiology, they manifest themselves differently at different hatcheries and may be two distinct maladies.

RECOMMENDATIONS

Supplement commercially produced OP-4 diet with pantothenic acid and utilize as the principle diet for summer chinook fry at McCall Hatchery.

Investigate the possibility of acquiring warmer water temperatures for early indoor rearing of fry.

LITERATURE CITED

Hutchinson, B.G. and A.J. Chacko. 1985. Evaluation of five diets on the occurrence of spring thing. Idaho Department of Fish and Game.

Ketola, H.G. 1985. Study of the etiology of early mortality in spring and summer chinook salmon. U.S. Fish and Wildlife Service. Cooperative Agreement No. 14-16-0009-1500.

National Research Council, National Academy of Sciences. 1981. Nutrient requirements of domestic animals. No. 16. Nutrient requirements of coldwater fishes. National Academy Press, Washington, D.C.

Thorpe, J.R. and B.G. Hutchinson. 1983. Survival and growth of summer chinook salmon fed five different diets. Idaho Department of Fish and Game.

Wood, J.W. 1979. Diseases of Pacific salmon, their prevention and treatment, third edition. State of Washington, Department of Fisheries, Hatchery Division.

Submitted by:

Bill Hutchinson
Assistant Hatcheries Manager, Resident

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Jerry M. Conley, Director

David L. Hanson, Chief
Bureau of Fisheries

Steve Huffaker
Anadromous Hatcheries Supervisor